A Fundamental Equation of State of Normal Octane

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A critical analysis is carried out for the experimental thermodynamic properties of n-octane – density ρ, isobaric heat capacity C_ρ, isochoric heat capacity C_v, enthaly H, and sound velocity W. The equation of state is obtained by treating the thermal and caloric properties together. The equation is valid at temperatures from the triple point to 630 K and at pressures up to 80 MPa.

The fundamental equation of octane is the equation for dimensionless Helmholtz free energy and reads

$$A(\omega, r) = A(\rho, T) = \alpha^0(\omega, \tau) + \Delta\alpha(\omega, \tau),$$
$$\Delta\alpha(\omega, \tau) = \Sigma\, \alpha_K \omega^l \tau^j \exp(-\gamma\omega^1)$$

Where $\alpha^0(\omega, \tau) = A^0(\rho, T)/R$ is the ideal gas part of the Helmholtz free energy, α is the dimensionless density,and τ is the dimensionless temperature. The form of the equation and the optimal number of coefficients are determined from the best description of C_p and density values at the same precision. The equation can calculate all thermodynamic properties in the region of validity with an uncertainty very close to that of the experimental data. The equation has a form proposed by Sengers *et al.* The paper contains the thermodynamic properties of n-octane and comparisons of calculated thermodynamic properties with the experimental and published properties.